
Intelligent Work- stations: Connecting the End User

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I INTRODUCTION

A. SCOPE

- This report, produced by INPUT as part of the end-user systems planning service, examines applications and relevant issues for intelligent workstations (IWS) in the corporation.
- This topic was selected because of client interest and because of user confusion regarding definitions and applications of these systems.
- Users are uncertain of the benefits of "intelligent workstations" and of how these systems differ from those already in place. Users are unclear about why IWS should replace "dumber" systems and how the cost of IWS can be justified.
- The purpose of this study is to help information systems (IS) executives determine appropriate applications for intelligent workstations, to clarify distinctions between these and similar systems, and to examine issues involved in adding intelligent workstations to the office environment.
- The study is also designed to serve as a guide to planning IWS implementation.
- This report includes the following:
 - Definitions and product classes fitting the definition (Chapter III).

- Compatibility, implementation, and ergonomic issues of IWS (Chapter IV).
- Trends in IWS usage, marketing, and technology (Chapter V).
- Conclusions, recommendations and summary (Chapter VI).
- Definitions of terms used in this report (Appendix A).
- A questionnaire used in researching this report (Appendix B).
- A profile of representative products (Appendix C).

B. METHODOLOGY

- INPUT first questioned several of its subscription clients to determine what topics should be considered and what issues should be clarified in this report. Among those interviewed were administrators responsible for IWS implementation and management.
- Extensive review and analysis of product literature, industry publications, and follow-up interviews with vendors and third-party experts added to the information evaluated in this report.
- INPUT's recent consulting studies have included several that address work-station issues. Although no proprietary information from these engagements was used directly for this study, these projects provide INPUT with an in-depth sensitivity to user requirements.

C. RELATED INPUT REPORTS

- Interested readers are referred to the following INPUT reports:
 - Executive Workstation Acceptance: Problems and Outlook (1984).
 - Impact of Office Systems on Productivity (1983).
 - Methods of Cost/Benefit Analysis for Office Systems (1983).
 - Selecting User Friendly Operating Systems for Personal Computers (1983).
 - Personal Computers in the IS Strategy (1982).
 - End-User Micro-Mainframe Needs (1984).
 - Micro-Mainframe: Telecommunications (1984).
 - Micro-Mainframe: Personal Computer Market Opportunities (1984).
 - Micro-Mainframe: Processing Services and Turnkey Systems Market Opportunities (1984).

II EXECUTIVE SUMMARY

- This executive summary is designed in presentation format to help the reader quickly review key research findings and recommendations. It will also provide an executive presentation, complete with script, to facilitate group communications.
- The key points of the entire report are summarized in Exhibits II-1 through II-3. On the left-hand page facing each exhibit is a script explaining that exhibit's contents.

A. A QUESTION OF DEFINITIONS

- The term "workstation" was used in the 1920s and 1930s to describe the place where work is performed. Later it came to mean the furniture designed for data processing. In the mid 1970s, the term was applied to the equipment itself. It now refers to an area where an information worker uses a micro-computer or terminal to perform any task.
- The term "intelligence" implies local capabilities beyond those made possible by connection to a remote computer. Various office equipment is labeled "intelligent" by vendors, and some consider the term to have a marketing definition.
- There is little agreement among information systems (IS) managers, end users, or vendors on the definition of intelligent workstations (IWS).
- Based on user and vendor interviews, INPUT defines intelligent workstations as similar to single-user microcomputers, except that the user is unaware of the technical complexities of application processes. In other words, it is "transparent." In addition, intelligent workstations are designed for and adjusted to one information worker, are regularly used for high-speed communications to other workstations and larger computers, and may have integrated voice communications capability.
- The optimum intelligent workstation is a theoretical model that removes the distance between worker and information using natural languages and ergonomic design elements. Such a model features integrated rather than "desktop" units, used as the primary tools for information creation and management.

A QUESTION OF DEFINITIONS

- **Little Agreement on the Definition of “Intelligent Workstation”**
- **INPUT’s Definition: An Intelligent Workstation**
 - **Is Similar to Single-User Personal Computers**
 - **Is Transparent between Applications**
 - **Enables High-Speed Communications with Other Computers**

B. CLARIFYING BLURRED DISTINCTIONS

- Distributed processing brought computer power to the end-user department level. Like microcomputers, but with greater capabilities, intelligent workstations bring that power to the end user, adding a distributed, communicating layer of computing use, effectiveness, and knowledge to the organization.
- Terminals do not provide the same flexibility as IWS, and microcomputers are designed primarily for standalone use, although they can serve as intelligent workstations with the proper communications capabilities.
- Intelligent workstations offer higher communicating speeds with much of the intelligence applied at the user interface for easier operations.
- Different classes of IWS may be appropriate for various end-user functional levels, but an intelligent workstation is not an appropriate solution for all needs; terminals, dedicated word processing/data entry systems and stand-alone micros still have their place.
- Implementation of IWS is similar to that of other office computers. However, earlier corporate microcomputer acquisition often bypassed IS. That experience has led to the development of procedures that will address potential IWS problems in advance.
- Justification for IWS should come from end-user departments, but IS should coordinate implementation to ensure that benefits are realized and problems are avoided.

CLARIFYING BLURRED DISTINCTIONS

	IWS	MICROS	TERMINALS
Computing Characteristics	Distributed	Stand-Alone	Centralized
Customization	End-User Tailoring	Less Flexible	Little Flexibility
Communications	High-Speed Integrated	Low-Speed Add-On	Only to CPU
Justification Responsibility	User Coordinates with IS	End User	Part of Central Services

C. RECOMMENDATIONS: PROTECT THE INVESTMENT, PROTECT I.S.

- IWS intelligence allows for an easier user interface and the flexibility to customize the unit to each end user's unique needs. Accordingly, INPUT recommends careful analysis of where IWS capabilities can be appropriately used in the organization to replace less capable computers, terminals, or manual systems.
- IWS should be used when local processing, communications capabilities, and tailoring the unit to the end user's needs are required.
- Because of the increased costs of IWS, acceptance is more important than for less expensive units. Therefore, IWS solutions should first be implemented with workers who are already familiar with computerized tools. Microcomputers are a migration path to these more powerful communicating units.
- Justification of intelligent workstations should be the responsibility of end users and departmental managers to avoid blame for unrealized benefits being directed to IS.

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RECOMMENDATIONS: PROTECT THE INVESTMENT, PROTECT I.S.

- **Implement Where Capabilities Are Most Appropriate**
- **Micros Present a Migration Path to More Powerful and Expensive Intelligent Workstations**
- **End-User Justification Protects IS**

III INTELLIGENT WORKSTATIONS: DEFINING THE TOOLS

A. GENESIS OF THE TERMS

I. WORKSTATIONS IN GENERAL

- The term "workstation" was originally used in the 1920s and 1930s to describe the place where work is performed. Later, the term came to describe the furniture designed for data processing. It wasn't until the mid-1970s that the term was applied to computer equipment itself.
- A workstation is now generally defined as the place where a worker uses a computer or terminal for various integrated tasks such as word processing, management inquiry, data entry, program development, graphics processing, and computer-assisted design and engineering (CAD/CAE).
- There is substantial overlap between the abilities of intelligent terminals, microcomputers, and workstations; and the boundaries for these terms are determined by performance and storage capacity.
- Workstations can be focused on specific user needs.

a. Executive IWS

- Executive workstations are often categorized by small "footprints" and attractive design features including customized cabinetry. They are used casually for electronic mail, smart telephone features, calendaring, and accessing data base information and reports prepared by senior management staff.
- Heavy information entry is not required. Executive IWS, therefore, may feature undersized keyboards, touch screens, or mice.
- INPUT's 1984 report Executive Workstation Acceptance: Problems and Outlook discusses this product class in depth.

b. Managerial and Professional Staff IWS

- Middle and line managers use IWS for decision support, cost accounting, project management, report preparation, and messaging.
- Professional personnel use IWS for financial analysis and specialized applications such as graphics and CAE/CAD.

c. Support IWS

- Secretarial staff members use IWS for document preparation, graphics, messaging (including Telex communications), and other support functions.
- The following equipment may be associated with intelligent workstations: facsimile (FAX) units (with soft copy CRT display), optical character recognition (OCR) input devices, call directors, microfiche viewers, and teleconferencing devices such as speakerphones or video monitors. Implicit in the definition of IWS is connectivity with coworkers' computers, departmental processors, or corporate mainframes.

2. INTELLIGENCE IN GENERAL

- The term "intelligence" implies more local capabilities than is provided by a passive system. Vendors attach the term to intelligent copiers, typewriters, terminals, telephones, and intelligent voice/data terminals (IVDTs). Generally, vendors do not use the term "intelligence" in reference to microcomputers, but clearly microcomputers are "intelligent."
- During interviews with IS managers, end users, and vendors, INPUT experienced difficulty finding agreement on definitions of various "intelligent" devices. Some consensus did emerge, however.
 - Intelligent terminals support local processing before information in the terminal buffer is uploaded to a departmental processor or mainframe.
 - Intelligent telephones bring computerized directories, auto dialing, and short messaging capabilities to CRT- or LCD-equipped telephones. They are designed primarily for verbal- rather than text-oriented executives (and sometimes for telemarketing applications) and therefore often have undersized keyboards. Intelligent telephone features can be added to microcomputers with plug-in boards.
 - Intelligent voice/data terminals are those combining computer terminals, data communications equipment, and telephone technologies. They support simultaneous voice and data communications and are more flexible than intelligent telephones or terminals of any intelligence.
 - Microcomputers are relatively inexpensive, easily operated, standalone, single-user systems with limited, usually "add-on" communications capabilities. In the proper configuration supporting high-speed communications, micros essentially become intelligent workstations.

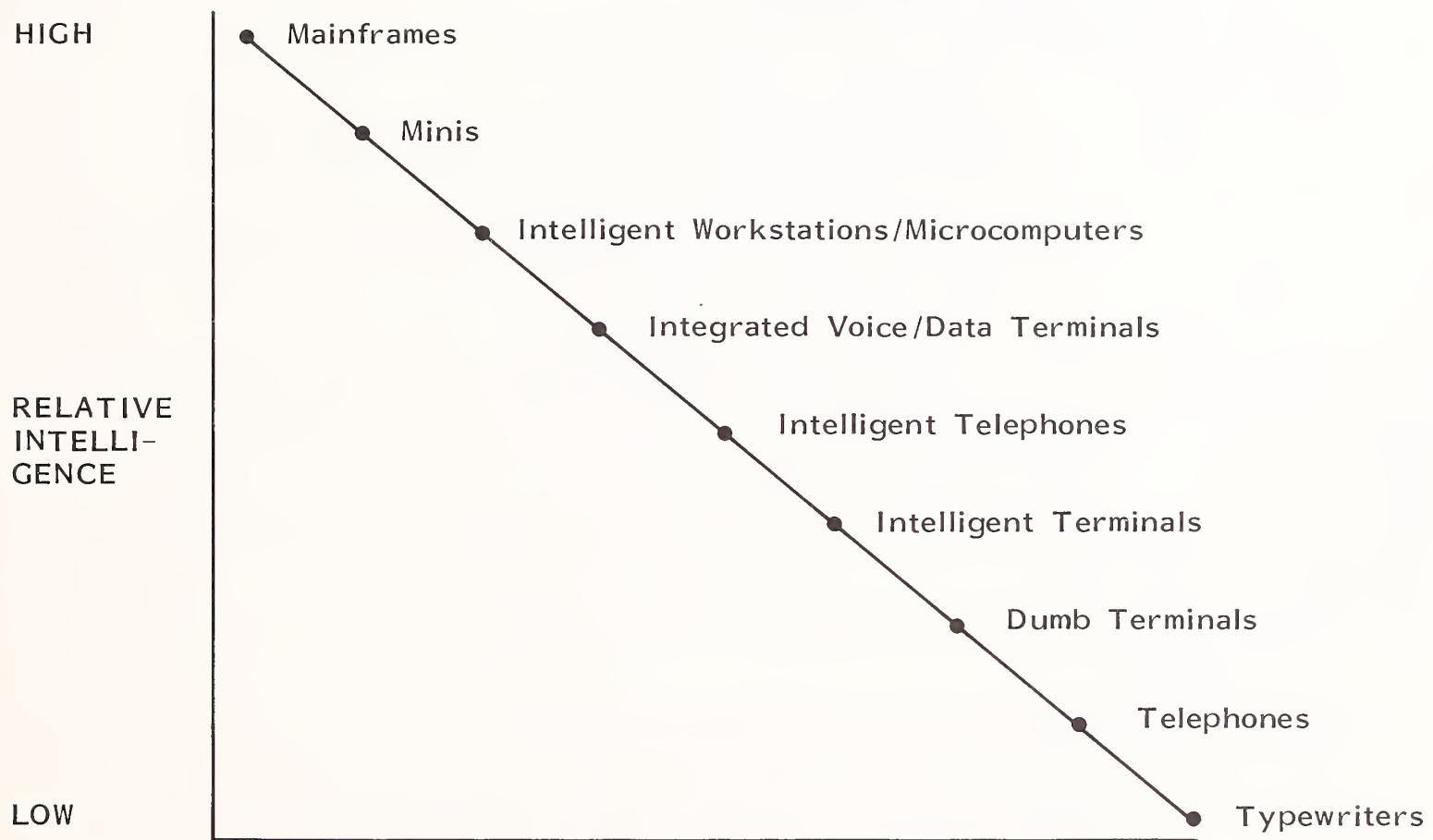
- Exhibit III-1 depicts a relative intelligence scale of office systems and intelligent workstations.

3. INTELLIGENT WORKSTATIONS

- The term "intelligent workstation" is one that causes confusion, since it can mean many things. Some people consider it to be a term simply invented by vendor marketing departments, a "buzzword" that attempts to encapsulate complex concepts and functions.
- One respondent felt that labeling workstations as "intelligent" implies user "dumbness."
- Some typical vendor and user comments define an intelligent workstation as:
 - "Able to input a program at the workstation."
 - "Devices that are programmable and have logical analysis capability in the device rather than using a mainframe's processing power."
 - "A multitasking system that ideally uses natural language and is applications independent."
 - "Gives you access to anything you want on a mainframe, on another PC, or on any data base."
 - "An interactive system that has a modem."
- These comments essentially describe user friendly microcomputers that have integrated communications capability and that are used regularly to "talk" to other systems.

EXHIBIT III-1

INTELLIGENCE SCALE



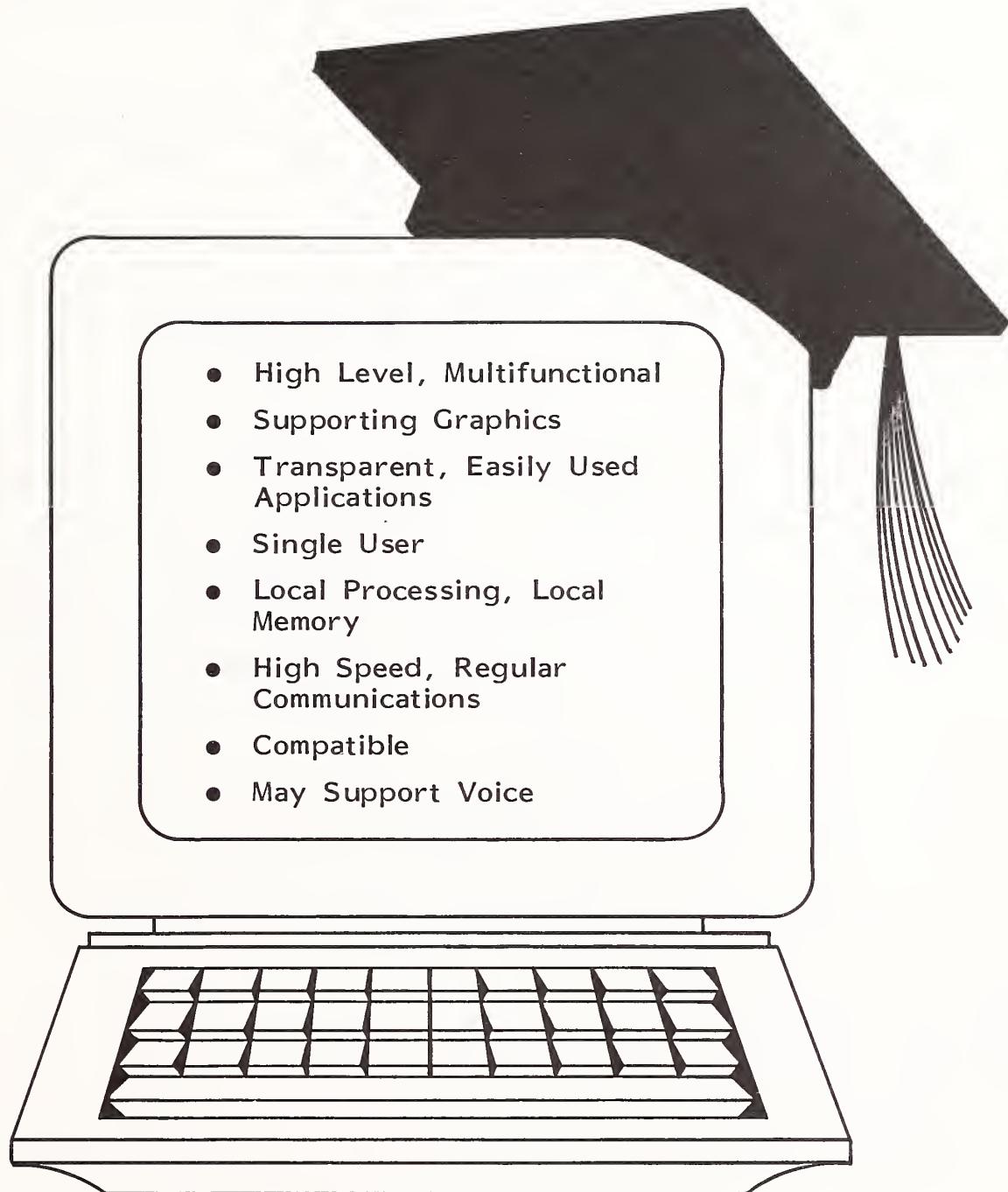
4. INPUT'S DEFINITION OF IWS

- INPUT's definition of intelligent workstations, as shown in Exhibit III-2, is based on the results of its survey.
- INPUT defines the intelligent workstation as:
 - A high-end, multifunctional microcomputer with graphics capability.
 - Having transparent, easy-to-use applications.
 - Designed for and adaptable to primarily one information worker.
 - Having at least one disk drive for memory storage and for loading local processing applications.
 - Capable of supporting high-speed (up to 19.2 Kbps), regular data communications.
 - Being compatible with other systems in the user environment.
 - Capable of supporting voice communications.

5. MICROCOMPUTER/IWS DIFFERENCES

- The difference between micros and IWS are subtle, centering on communications and communications speed.
- Whereas micros use technologies identical to intelligent workstations, they are designed generally as standalone systems and are not primarily for communications. When equipped with modems they will usually communicate at 300, 1,200, or perhaps 2,400 bps. IWS, on the other hand, will be directly or indirectly linked to departmental or mainframe computers and communicate at higher speeds (up to 19.2 Kbps).

INPUT DEFINES INTELLIGENT WORKSTATIONS



- Exhibit III-3 compares the features of micros and IWS.

6. THE OPTIMUM IWS

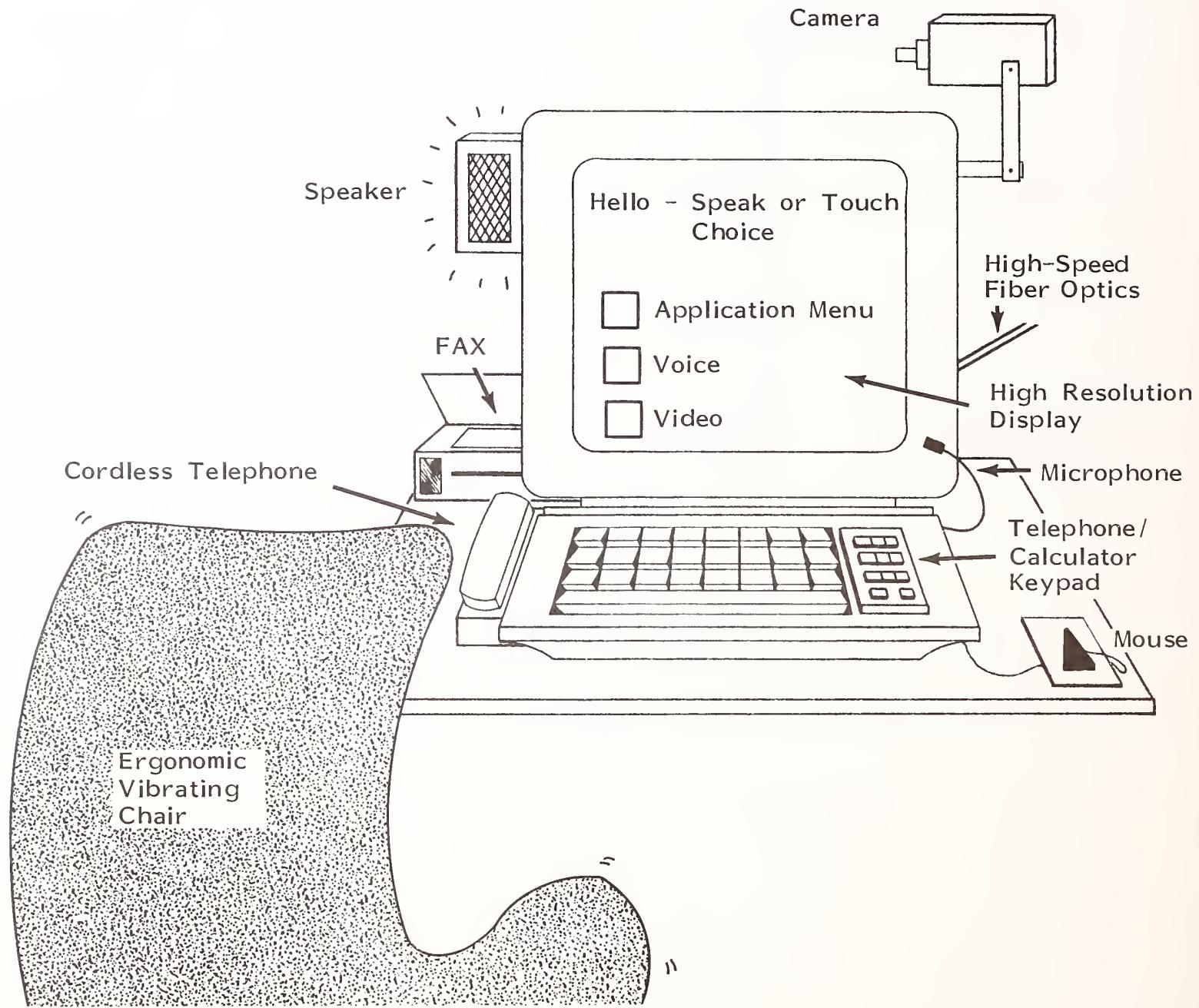
- The theoretical optimum intelligent workstation goes beyond a desk-top unit to a working environment that removes the distance between worker and machine.
- An analogy to the optimum IWS is a sports car cockpit with easily reached controls, where human and machine essentially become one system.
- In the optimum configuration, the user conducts all work through the system. Featuring a high-resolution display, the workstation integrates smart telephone features, desk-top videoconferencing, FAX, calculator, voice processing, voice command, touch screen or mouse, natural language software, and high-level ergonomic design elements including custom cabinetry, nearby environmental controls, and special chairs with built-in vibrators to stimulate the sedentary user.
- The technology for the optimum workstation exists today, but no vendor offers a system integrating all its functions yet. Mind and machine linkage, a topic for science fiction writers and futurists, would clearly represent the arrival of such a system.
- Exhibit III-4 is an artist's concept of the optimal workstation.

EXHIBIT III-3

MICROCOMPUTERS VERSUS INTELLIGENT WORKSTATIONS

	MICROS	IWS
TECHNOLOGY	Microprocessors, Keyboards, Memory, VDT	Same
EASE OF USE	Relatively User Friendly	Very User Friendly
COMMUNICATIONS	Add-On Low Speeds: 300, 1200, 2400 bps	Integrated High Speeds: Up to 19.2 Kbps
INTEGRATION	Designed Primarily for Standalone Operation	Designed to Work with Other Systems

THE OPTIMUM INTELLIGENT WORKSTATION



B. PRODUCT CLASSES FITTING THE IWS DEFINITION

I. GENERAL PURPOSE, UNIVERSAL WORKSTATIONS

- Universal workstations are capable of serving various functions, and the term is applied in the same way that "vanilla" is used to describe a generic printer type.
- Representative products identified by respondents are ROLM's Cedar with IBM PC compatibility and intelligent telephone features, the IBM 3270 PC which communicates with mainframes and has local processing capability, and Convergent Technologies's N-Gen workstations. These and other workstations are described in Appendix C.
- General purpose micros with high-speed linkages to departmental or mainframe computers may be considered general purpose intelligent workstations.
- Some vendors maintain that the universal workstation concept is fallacious and that generic solutions are too simplistic. INPUT feels that workstation functionality is determined by application and design elements like keyboards configured for specific functions such as word processing or graphics composition. The hardware itself may in fact be "universal."

2. SPECIAL PURPOSE IWS

- Document Processing IWS: Special purpose IWS are those dedicated to specific primary functions. These include multifunctional processing systems, such as those offered by Wang, or the Convergent workstations sold as OEM products, which merge advanced word processing features with data communications.

- CAE, CAD, CAM IWS: Sophisticated graphic manipulation, computational capabilities, and process control functions are found in computer-aided engineering, design, and manufacturing systems (CAE, CAD, CAM). Representative products are Apollo's Domain, Sun's Workstation, and Hewlett-Packard's 9000.
- Trading Turrets: Designed for the financial community, these systems integrate multiple voice lines, several incoming data streams, order entry, and data base applications in highly responsive systems. Turrets can be adapted for dispatch centers and police or military "command centers." Representative products include IPC's Series II, Centel Financial Systems's ITS 8300, ATT-IS's ComCore and "the Turret" from Turret Equipment Corporation.
- Telemarketing Workstations: As implied, these workstations adapt data base, order entry, and time/facilities reporting applications to manage voice communications. Representative products include Telemarketing+, offered jointly by Prime Computers and MSI.
- Portable IWS: A representative portable IWS is the lap-top Grid Compass, integrating smart telephone features and an on-board modem, which other portable computers generally do not. The Compass can remotely network to any mainframe, mini, micro, or printer through a company-offered server.
- In order for systems to be used productively, making it possible for benefits to match expenses and making the task of managing the issues they involve worthwhile, system abilities and user requirements must match. The next chapter examines implementation planning and ways of justifying intelligent workstations.

IV ISSUES

- The microcomputer explosion of the past several years created difficulties for IS, which found itself under increasing pressure to support proliferating systems that were often directly purchased by end users who bypassed IS.
- IS was viewed by some as antagonistic toward end-user computing, but fortunately these views are changing. Many companies have established micro centers within IS departments representing a commitment to support approved microcomputer hardware and software.
- IWS issues are essentially the same as the microcomputer issues of the immediate past. They include compatibility of systems, planning procedures, justification, supporting systems, and ergonomics.

A. BENEFITS AND LIMITS OF IWS

- Although micros and IWS have similar characteristics, the potential value of IWS is greater than micros, due to increased communications capabilities, flexibility, and ease of use.

I. BENEFITS

- IWS can be tailored to the individual. A shared computer's functionality is compromised by the need to serve many users, and terminals are affected by these compromises.
- IWS applications can be developed and performed directly by the end user, resulting in faster, better, and cheaper processing that requires less IS support. Terminals depend on the host computer for application development.
- IWS, using off-the-shelf software, can handle processing for which applications may need to be written in-house if run on the corporate mainframe. Because of their flexibility, IWS can be configured to broad user application needs. Terminals use host applications or the device's limited built-in capabilities, which may not serve specific requirements.
- IWS are valuable for applications that are uneconomical or inconvenient on a shared host. The IWS (and microcomputer) capabilities for spreadsheets, graphics, and word processing may exceed those of the mainframe. One-time-only problems, rush jobs, or reports that cannot wait for scheduled runs can be done on IWS. Timeliness of the information, then, is improved by data access on demand.
- Ideally, workstation intelligence reduces training requirements. IWS widely distribute computing knowledge and computing use; hands-on experience is often more valuable than theoretical training.
- Intelligent workstations represent the next stage in increasingly demanded micro-to-mainframe linkages because they are designed for communications, whereas micros generally have add-on communications capabilities at lower speeds and are designed primarily for standalone use. IWS' use of host software can be strategically important but can also lead to problems, which will be discussed shortly.

- IWS support external data base access via public networks, bypassing corporate facilities once they are on an outside line. External electronic mail is also accessed directly. External access by terminals is possible only through the main CPU. Depending on their intelligence, they offer limited or no local manipulation or storage of external information.
- Although IWS may cost more on a per-unit basis than dumb terminals, they use less of the host computer, resulting in favorable comparisons, especially in view of added functionality.
 - Intelligent workstations are priced at approximately \$6,500-10,000; the price of terminals ranges between \$400 and \$1,200. Microcomputers intended for business use range in price from \$2,500-3,500.
 - Actual prices depend on configuration. Economies of scale and the effects of competition are generally lowering prices in all product classes.
- IWS can be a status symbol for users and corporations, demonstrating one's participation in the information age and indicating computer competence to coworkers, supervisors, and most importantly to clients.

2. LIMITS

- Despite their flexibility, IWS may not be appropriate for repetitive, standardized tasks such as data entry and word processing.
- End users may attempt to use IWS for problem solving when mainframe processing is required, resulting in wasted resources from aborted attempts at inappropriate solutions.
- Software for IWS may be more costly than micro versions of similar software.

- Accessing host applications leads to increased demand for mainframe processing and requires consideration of compatibility issues.
- Increased internal communications can tax corporate networks. External communications can increase costs. Offsetting these factors are productivity gains.
- Improperly introducing IWS to the corporation can trigger computer backlash. Not everyone wants to use a computer, and the technology may be threatening to some individuals. Those excluded from using the system may also become mistrustful and envious of those who use it. Computer awareness is becoming widespread, but nonusers still need to understand specifics to avoid negative feelings.
- New technologies, as represented by IWS, may be seductive, blinding IS and users to problems such as the need for computer training, the need for compatibility between systems, the need to maintain security and back-up electronic files, and the impact on corporate computing and communications resources.
- Exhibit IV-1 compares the benefits and limitations of IWS.

B. PLANNING IMPLEMENTATION

- A comprehensive planning process is helpful in evaluating the usefulness of IWS over other solutions for each individual worker.
- In many organizations, micros proliferated without IS involvement. But IS received demands for support and pressure to link micros to the corporate network. The policies and practices developed earlier from microcomputer

EXHIBIT IV-1

BENEFITS/LIMITS OF INTELLIGENT WORKSTATIONS

BENEFITS	LIMITS
Allows Individual Tailoring	Not Needed for Standard Tasks
Enables User Application Development	Inappropriate for Some Problems
Uses Available Software	Software May Be More Costly than Microcomputer Versions
More Convenient, Economical than Host Processing	Wasteful if Mainframe Processing Required
Less Training Required	May Trigger User Backlash, Mistrust
Can Use Host Applications	Increases Mainframe Processing Requirements
Allows External Data Base and E-Mail Access	Increases Communications Costs
Status Symbol	May Be Acquired for the Wrong Reason
Considering Functionality, Compares Well to Terminal and Micro Costs	Seductive "New" Technology May Blind Users to Problems

experiences are now being applied to IWS. Generally, IS is now "in charge" of implementing IWS installations.

- The implementation planning process should help build alliances across departmental lines. This is politically important since involved personnel are more likely to accept and endorse recommendations.
- Some IS managers report requiring end users to justify IWS and micros for their departments. This too is politically wise. The user must live with the system and the reasons for installation and will often attempt to transfer culpability for unattained benefits to the justifier.
- The first step in planning the implementation of IWS is to determine which departments or individuals require this solution and what level of "intelligence" and communications ability is required for each function.
 - For example, it may not make sense to replace typewriters with IWS if simple typing and no communications is required. Perhaps dedicated word processors or display or electronic typewriters would be more appropriate.
 - Also, data entry and low-speed dial-up timesharing functions may not require the high-speed communications and processing capabilities of IWS.
- Determining who requires IWS can be accomplished by surveying department heads or, in large corporations, by circulating a questionnaire approved by departmental managers. The goal is to identify the proper tool, at an acceptable price, for each individual situation.

I. ISSUES AFFECTING PROJECT DECISIONS

- A number of broad questions must be answered in approaching the implementation plan.
 - a. Organizational Issues
 - Does the company recognize a need to remain competitive by installing modern facilities?
 - Does the company appreciate the value of communicating workstations as contributing to productivity and profitability?
 - Does the corporate image require using advanced technology? This factor may override an unclear cost benefit justification. The company may want to demonstrate to customers and clients its participation in the information age.
 - b. Financial Issues
 - Is the climate favorable for equipment purchases?
 - Will IWS purchases be charged to user department budgets? If not, how will the purchases be budgeted?
 - Is the IWS solution cost-effective for specified needs?
 - c. Equipment Issues
 - Has the company added noncommunicating terminals and freestanding microcomputers? If so, does this indicate poor timing for new equipment purchase recommendations? What are existing lease terms and when will it be more appropriate to evaluate IWS solutions?

- Can intelligent workstations replace or supplement other equipment?
- d. Compatibility Issues
- Compatibility of IWS with other office equipment is one of the leading issues IS faces as part of the end-user computing revolution.
- Appropriate responses "up front" include approved vendor lists, IS purchasing coordination, hardware and software standardization, compatible file structure design, and coordination with vendors to ensure system cohesiveness.
- Other solutions involve conversion of the company's data bases (either in-house or through service bureaus) and installation of protocol converters.
- Exhibit IV-2 summarizes compatibility issues and solutions.

- e. Support Issues
- The IS manager should also consider if IWS installation will require training support. If so, how will this be managed? One solution is to recruit interested users as departmental trainers to supplement other training.
- How will IS deal with maintaining various models of IWS, micros, and terminals and with stocking replacement parts and supplies?

2. CURRENT AND FUTURE REQUIREMENTS REVIEW

- a. Coordinate a Needs Assessment
- It is important to understand the company's information management processes. IS may coordinate a needs assessment, delegating the particulars to individual departmental managers. IS should:

EXHIBIT IV-2

COMPATIBILITY PROBLEMS/SOLUTIONS

PROBLEMS	SOLUTIONS
Hardware Connections	Approved Vendors, Purchasing Coordination
Operating Systems	Standardization
Software	Standardization
Data Formats	Compatible Design, Protocol Conversion

- Determine how equipment is currently distributed.
- Identify each area suitable for IWS solutions focusing on the need for flexible, multifunctional, high-speed communicating workstations.
- Identify who is better served with terminals or standalone micros.
- Coordinate with personnel who determine placement and decide how conflicts will be resolved.
- Examine current methods.
 - What information is processed and transmitted?
 - Are floppy disks physically routed?
 - Are low-speed transfers common?
 - What improvements will IWS bring to timely information processing and distribution?
- Map organizational structures showing work relationships and physical and electronic communications links. IWS must consider changes that IWS capabilities may dictate in the near future.
- Deal with departmental and company growth plans and consider how the number of intelligent workstations may increase due to those plans. What long-term need does IWS address?

● The needs assessment can be part of a broader look at the company's information processes. Specific procedures relating to IWS evaluation are:

- An equipment inventory to identify terminals that can be replaced to increase productivity.
- A user survey to determine likes and dislikes about current methods.
 - . The survey should determine what features are wanted. For example, how important to each potential user are high-speed communications, color graphics, "smart" telephone features, and teleconferencing features supported by IWS?
 - . The survey should identify cases where unavailable information, slow reports, delayed processing, and poor communications have caused lost time, bad decisions, poor customer response, or lost orders.
- Traffic statistics for functions that would be supported by intelligent workstations: electronic messaging, data base access, and information center functions. IS must evaluate the anticipated impact on the corporate network.
- If the needs assessment does not lead to an IWS implementation decision, the process will help determine how best to handle present information management and evaluate the need for additional terminals or standalone microcomputers.

b. Understand Corporate Goals

- IS should look for mandates in corporate and divisional strategic plans to bring IWS capabilities (high-speed communications, local processing, and multifunctionality) to individual information workers.
- This will enable improved manpower utilization, higher departmental productivity, better decision support, and timely reporting.

c. Analyze Corporate Financial Considerations

- What funds are available? What are the limitations? Will funds be available in the future?
- What are the anticipated ongoing expenses for supplies or training, and who will be responsible--IS or the departments?
- What are company policies governing capital equipment? Should equipment be leased, rented, or purchased?

d. Recognize Corporate-Culture, Personnel, and Political Factors

- Perhaps the most wide-reaching issue that IWS planning may trigger, especially when replacing manual systems, is: "What organizational changes make sense for addressing and supporting the future information management needs of the company?" Manual systems are often supported departmentally, whereas computerized solutions may require expertise not available at that level.
- What is the corporate self-image? Will it dictate functional or stylistic decisions?

e. Evaluate the Alternatives

- Gather and organize vendor information, attend trade shows, and talk with industry peers to gain perspective.
- Product evaluation is possible through short-term leasing or with "loaners" from vendors. Interview users of the equipment you are considering, particularly those in similar organizations.

f. Isolate the Decision Points

- Once decisions have been made for each user or department, the specifics must be addressed.
- Micros versus special purpose IWS: Individual departments or staff may require different IWS configurations or standalone microcomputers, determined by need and function.
- Connectivity: Is the company planning a local area network (LAN) solution? If the PBX is becoming obsolete, will a fourth-generation PBX (with voice/data integration) be an appropriate solution? What about other communications solutions such as data PBXs for connecting IWS to the network?
- Compatibility: Will products being considered interface with existing computers and peripherals? Will departmental processing configurations be changed based on the added capabilities of IWS?

3. IMPLEMENTATION

- Generally, it is a good idea to follow the threefold approach to implementation. This follows a progression with low investment at the outset when the risks are greatest.
 - Prototype. One user community tests a portion of the plan. This stage is designed to discover and assess technical weaknesses. Several competing products (leased or loaned) may be tried to determine what is best on a departmental or job function basis.
 - Pilot. This is a wider implementation that seeks to identify human rather than technical factors that need to be considered to confirm the IWS solution or to indicate if the solution is an "overkill" (i.e., if

terminals or standalone microcomputer solutions are more appropriate). This stage can also test assumptions on "before" and "after" productivity levels.

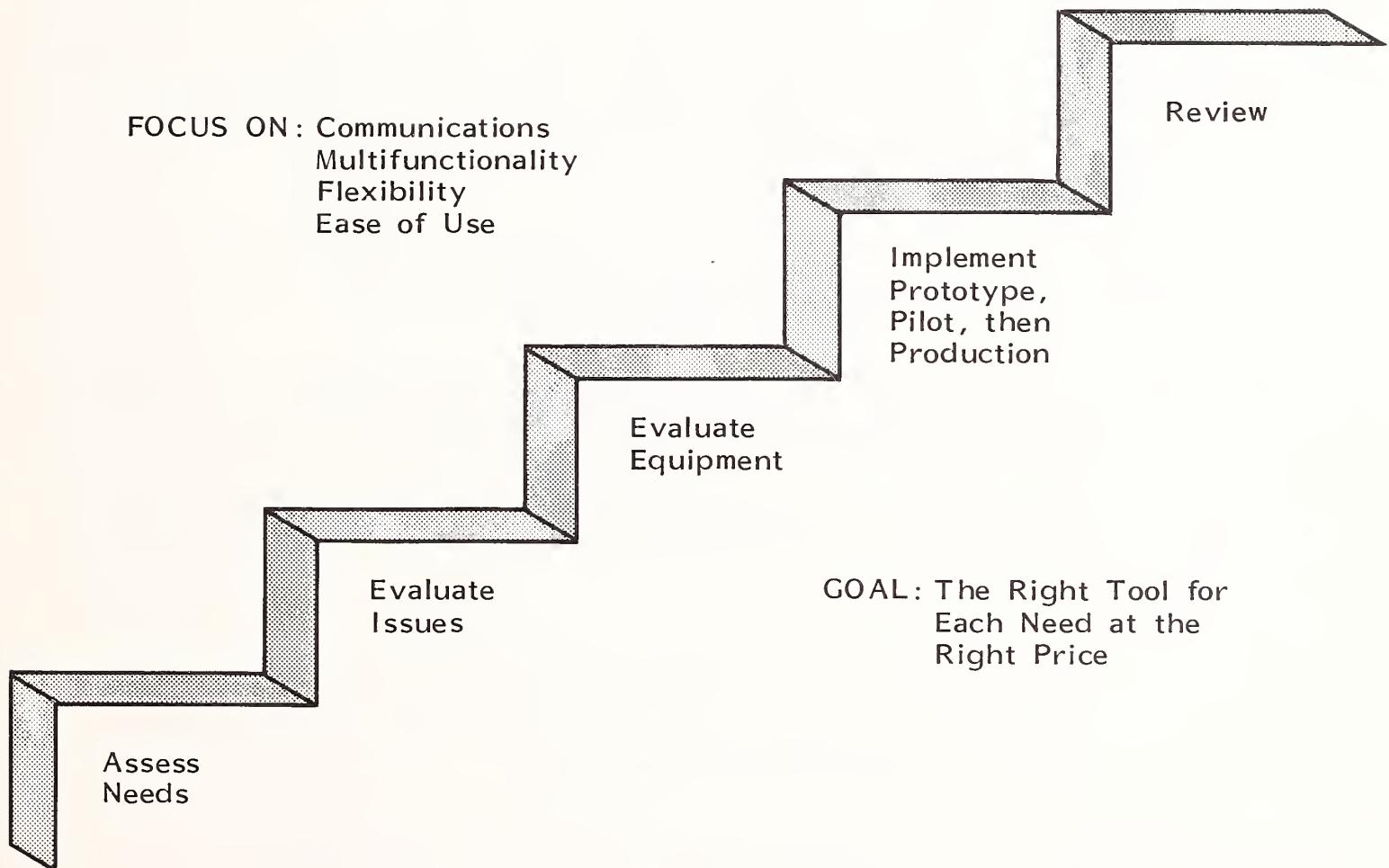
- Production. This is a full implementation. The original plan may be modified based on earlier experiences.
- After full implementation it is important to conduct a review to determine if projected benefits are being actualized and, if not, what can be done to improve the situation.
- Exhibit IV-3 charts the key steps toward IWS implementation.

4. JUSTIFYING INTELLIGENT WORKSTATIONS

- Respondents for this study said that justifying intelligent workstation expenses was a key issue they wanted this report to address.
 - a. Justification Based on Productivity
- Justifying any computerized system is appropriately based on increased productivity, but IS managers have difficulty quantifying these increases, and many rely on intuition.
- INPUT's 1983 study Impact of Office Systems on Productivity identified interpersonal communications as the largest time and cost factor in the office; analysis and decision making constitute the second most critical factor. Intelligent workstations serve these functions well.
- The IS manager may attempt to demonstrate IWS productivity improvements by prototyping systems and by evaluating the experience of other companies. Such analysis is often time-consuming and difficult.

EXHIBIT IV-3

KEY STEPS TO IWS IMPLEMENTATION



- The INPUT report concludes: "Lacking precise tools for measurement of the performance of office systems, relatively simple, intuitive measures will have to be used. Our assumptions are that decreased paper volume, transfer of time spent communicating to analysis and decision making, and acceptance of new office systems can be used as measures of productivity improvement. Unfortunately such measures are difficult to use as cost justification for the installation of new office systems."
- Increasingly, IS uses intangible benefits (increased effectiveness and quality of work productivity) to justify office system acquisition. Sometimes, however, conservative managers require "bottom line" tangible justification (cost displacement, reduced personnel costs, reduced backlog). They require that new system expenses more than displace old system costs.
- Because of the need to justify new systems, INPUT issued a companion study, Methods of Cost/Benefit Analysis for Office Systems.
 - This study recommended awareness of management types in order for justification to be consistent with their requirements. While conservative managers require hard figures, more progressive managers are interested in business opportunities, and in soft-dollar, intangible projections.
 - The study found that a minimal tangible justification was required for microcomputers and word processing systems; it is proper to extrapolate this finding to include IWS.
 - The most commonly cited intangibles were productivity-linked, value-added benefits.
- The 1983 study reported a case in which costs were attributed to office products (reports, proposals, etc.) to justify new office systems. Interested readers requiring tangible justification methods are referred to this report,

which cautions that the overriding weakness of such techniques is that too much time and money can be spent on the process.

b. Competitive and Corporate-Culture Justification

- Companies may wish to show clients their participation in the information age and their awareness of information management as a powerful competitive tool. The corporate image opportunities represented by intelligent workstations can be an important justification factor.
- The company may also demonstrate to its employees a commitment, in both word and deed, to staff productivity by bringing advanced systems such as intelligent workstations into use. This has the added benefit of improving morale and attitude, enhancing the company's collective self-image.

c. IS and Justification

- As noted earlier, IS should assist but not justify intelligent workstations for users who must live with the equipment and the reasons for installation.
- Users will often try to transfer responsibility for unattained benefits to the justifier.

C. ERGONOMICS

- Popular press articles have reported on the possible health risks and on worker's compensation claims from those allegedly harmed by video display terminals (VDTs) and personal computers.
- Primarily an issue with those stationed continuously at VDTs, ergonomics and health issues can be significant factors in the acceptance of less frequently

used workstations. Employee absences and errors from fatigue affect productivity, costing business millions of dollars a year.

- Eye fatigue, irritation, and muscular strain are the most common complaints. But emotional ailments, including stress, anxiety, depression, and sleeping disorders, have also been reported.
- Several states have laws on VDT safety, and lawsuits usually favor injured plaintiffs.
- The intelligent workstation investment is made to improve productivity. This is as much a function of how the tools are used as it is the comfort, convenience, and safety of the work place. It is somewhat ironic that companies are willing to invest in hardware but that the treatment of hardware operators is often an afterthought.
- Although vendors are generally responsive (no company wants to risk having its product labeled "unsafe"), INPUT recommends that IS diligently consider the physical and operational aspects of intelligent workstations with a view to preventing health problems. These aspects include indirect lighting, safe cable placement, rounded edged cabinetry, and comfortable workstation positioning.
 - To reduce arm strain, keyboards should be at a level below a normal desk top and the slope should be adjustable.
 - Chairs should conform to the individual, allowing freedom of movement to prevent cramping.
 - Reference documents and keyboards should be in a vertical line and at the same eye distance, to reduce refocusing when scanning from screen to document to keyboard. Glare should be reduced with built-in etched glass finishes or attached screens.

- Enlightened attitudes regarding work quotas and break periods can mitigate stress-related problems. Employee involvement in implementation helps eliminate concern.
- Employers have a legal obligation to provide an environment free of recognizable hazards. Attention to operator needs can facilitate acceptance of intelligent workstations because it indicates corporate concern for the individual.

V THE FUTURE OF INTELLIGENT WORKSTATIONS

- Intelligent workstations are being installed at virtually every level of the corporation to automate functions that were previously performed manually, and to increase productivity, replacing typewriters and terminals. IWS use is increasing.

A. USAGE TRENDS

- The future of intelligent workstations will parallel the immediate past of microcomputers. The boom in corporate micros will lead to demand for higher level technologies for micro and mainframe decision support applications.
- INPUT projects that corporate computing will grow at an average rate of 37% by 1990 when there will be 160 times more computing than in 1970. End-user computing will represent 80% of the total, with a shift from traditional transaction processing to analytical processing and decision support, which together will comprise 60% of all uses.
- Micro and mainframe applications will grow from less than 4% of all 1984 applications to 27% by 1988, with end users wanting to access and manipulate corporate data. This means greater use of intelligent workstations.

- INPUT projects the end-user population to include not only professional and technical staff, but first-level and middle management and a good portion of senior management as well.
- INPUT's user survey reveals a pattern of replacing manual systems, typewriters, and terminals with micros and IWS. As prices moderate, standalone micros, smart terminals, and word processing systems will be viewed as less cost-effective and less flexible than IWS, although dedicated systems will be maintained where flexibility is not a concern.
- A psychological dynamic in the trend toward intelligent workstation use is the desire to have local command and control over processing power. Distributed processing brings this to the departmental level, but shared processing may not be appropriate with highly interactive applications. Bringing processing and communications capabilities to end-user workstations extends this dynamic and serves practicality in many applications.
- The availability of local processing power leads to greater awareness of the distinctions between personal, departmental, and corporate information needs, satisfied by different (but interconnected) compatible processors that support the integration of future technologies.
- Personal processing is under end-user control. Although data may be downloaded, manipulation and analysis occurs at the workstation. The workstation is a window to the mainframe for data and applications, and it serves as a connection point to all resources on the network.
- Existing standalone systems will increasingly need to communicate, even to non-compatible operating environments. This requires emulation such as that provided by the IBM 3270 PC.
- Whereas IWS tends to reduce mainframe processing loads, opposing pressures due to increasing micro-mainframe linkage will result in net increases in mainframe activity.

- As user organizations recognize the need for connectivity, more local area networks (LANs) will be implemented. Companies replacing older PBXs will look to the so-called "fourth-generation" PBX (CBX) with integrated LANs linking IWS throughout the corporation.
- Corporate information distribution needs will lead to office videotex solutions for applications needing color graphics and easy use. IWS can serve as terminals for office videotex systems. INPUT's 1984 study LAN/CBX Trends: Decision Processes for Users and a 1985 report Office Videotex address these technologies.
- The voice/data capabilities of intelligent workstations may lead to more computer conferencing. Screens of data or documents are reviewed interactively with a simultaneous voice conference call involving two or more parties. IWS-based freeze-frame videoconferencing and image processing (such as that supported by the Wang PIC system) may be implemented, displacing facsimile in certain settings.
- Voice/data integration leads to merging technologies. For example, on DEC workstations, screen notification of electronic mail messages received shows voice mail message headers as well. If users want a voice message, they position the cursor on the corresponding item and the phone rings with the message. Text information can be converted and delivered audially through DECTalk.

B. MARKET TRENDS

- The microcomputer shakeout, which began in 1984, will carry over to the workstation segment, and the smaller companies, unable to strike OEM and distribution agreements, will fall by the wayside while the major office automation and microcomputer manufacturers jockey for lead market positions.

- Surviving independent vendors will shift attention from functionality, where fewer product differences are apparent, to stylistic and ergonomic differentiation.
- Vendors will work through microcomputer and IS managers rather than approaching the end user, meaning more IS review and control.
- Minicomputer companies will position their terminal products as intelligent workstations, keying on compatibility with their larger systems, and positioning new workstations as downsized minicomputers.
- Microcomputer-integrated smart telephones, which have failed to displace separate desk instruments, will be marketed through communications rather than computer channels in the hope of finding niches for "computerphones."

C. TECHNOLOGICAL TRENDS

- Advances in technology continue with Ultra Large Scale Integrated (ULSI) circuits coming to market in the 1988-1990 time frame, bringing increasing intelligence to smaller packages.
- Hardware developments will trigger software improvements with "friendlier" interfaces, higher levels of application integration, and even more end-user power. Artificial intelligence or expert systems workstations and natural language capabilities will make the user interface more transparent, addressing computerphobia and leading to greater acceptance of office automation solutions.
- Voice recognition/voice command and touch screens for certain applications such as executive IWS will find broader markets. Voice annotation and

end-user-system-based voice mail will mean more integrated productivity tools.

- Field service and sales personnel now embracing portable and notebook computers will find connectivity possible using cellular radio and other mobile data communications systems, allowing remote access to company mainframes.
- These trends are highlighted in Exhibit V-1.

EXHIBIT V-1

INTELLIGENT WORKSTATION TRENDS

USAGE TRENDS	MARKET TRENDS	TECHNOLOGICAL TRENDS
<ul style="list-style-type: none">● Increasing Use at all Levels Due to Needed Flexibility● Increasing Communications and Micro-Mainframe Applications● Increases in Mainframe Processing● Voice/Data/Image Integration	<ul style="list-style-type: none">● Vendor "Shakeout"● Stylistic and Ergonomic Product Differentiation● Vendors Work with IS - More IS Control● Vendors Position IWS as Small Minis● New Marketing Channels	<ul style="list-style-type: none">● ULSI● AI/Expert Systems/ Natural Languages● Voice Command/Touch Screens● Mobile Data

VI CONCLUSIONS, RECOMMENDATIONS, AND SUMMARY

A. CONCLUSIONS

- Because of their adjustability to the needs of the individual end user, and because of their capabilities as communicating workstations, IWS offer benefits to the corporation--but only if they are appropriately deployed, accepted, and used.
- The trend toward easier system use means that less-skilled personnel can achieve gains, and this will be to the company's benefit.
- IS, which was bypassed earlier by end users who purchased personal computers on the departmental level, is now in a position to take an active role in the implementation of IWS.

B. RECOMMENDATIONS

- INPUT recommends careful evaluation of where IWS can appropriately be used to replace less capable methods, focusing on computational power, communications abilities, and the ability to customize for user needs.

- To ensure acceptance and to protect the investment, IWS solutions should first be implemented among the PC "priesthood" of workers who are indoctrinated, educated users and who have accepted computerized productivity tools. Microcomputers are the migration path to these more powerful systems.
- Information workers who did not participate in the office personal computer "invasion" should not be bypassed, because they may now be agreeable to IWS solutions due to ease of use.
- Justification should be the responsibility of end users and departmental managers, but IS should take an active role to ensure compatibility of systems. This is accomplished by approved vendor lists and purchasing coordination.
- IS needs to anticipate the impact of IWS on corporate communications and mainframe computing facilities, as well as new issues that IWS may trigger.
- These recommendations are summarized in Exhibit VI-I.

C. SUMMARY

- Intelligent workstations are difficult to define specifically, but they represent the next phase (after the personal microcomputer phase) in end-user office automation and computing.
- By off-loading applications and processing from corporate mainframes and departmental processors, a larger community of users can be served. This results in efficient information management.
- End-user control of customized, computerized, communicating tools feeds the dynamic of bringing computing power to the information worker's level while

EXHIBIT VI-1

INTELLIGENT WORKSTATION RECOMMENDATIONS

- Focus on Capabilities in Evaluating Proper Placement
- Implement First among the Microcomputer "Priesthood"
- End-Users Justify, IS Coordinates
- Anticipate Impact on Communications and Processing Facilities

improving overall corporate information functions. This end-user control has psychological and practical benefits.

APPENDIX A: DEFINITIONS

- Automatic Dialing - A feature that allows users to call a number by positioning a cursor over a name or by entering a called party's name on the terminal.
- Computer Conferencing - Computer-based interactive messaging among multiple participants.
- Electronic Mail - A computer-based messaging system, available on a network or through gateways, to outside networks such as Telex.
- Executive Workstation - A small personal computer or terminal with customized cabinetry and limited features designed for executive use.
- Facsimile - Equipment on which images are scanned, transmitted as impulses, reconfigured as images, and duplicated on paper. Essentially, it is a communicating photocopy machine.
- Fourth-Generation PBX - A business telecommunications system that is programmable or software controlled and integrates a local area network.
- Intelligent Telephone - Also called a "smart" telephone, features computerized directories, automatic dialing, and short messaging capabilities with CRT or LCD displays.

- Intelligent Terminal - A terminal that allows some local processing.
- Intelligent Voice/Data Terminal (IVDT) - A computer terminal that combines data communications and telephone technologies and supports simultaneous voice and data communications.
- Intelligent Workstations (IWS) - Flexible, multifunctional devices similar to microcomputers, which regularly link to departmental or mainframe computers.
- Local Area Network (LAN) - A system allowing communications and equipment sharing within a building, intrabuilding, and intercampus.
- Microcomputer (Micro) - A relatively inexpensive, standalone, single-user system. Also known as personal computer (PC).
- Natural Languages Interface - A human-machine communications interface that translates the user's language--be it English, French, or whatever--into language understood by the computer. Natural languages do not require computer-specific commands.
- Office Automation - The application of a set of products and services to improve existing paper-based office procedures.
- Office of the Future - The application of new products and services, such as video- or teleconferencing, that will cause fundamental changes in existing office procedures.
- Office Systems - Includes both office automation and "office of the future."
- Transparent - The way in which a computer system handles applications without user awareness of the technical complexities of the process.

- Voice Mail - A form of electronic mail that digitizes and stores voice for transmission, manipulation, and later retrieval.
- Workstation - An area where an information worker uses a microcomputer or terminal to perform tasks.

APPENDIX B
QUESTIONNAIRE

INPUT is conducting a study on Intelligent Workstations in the corporation. We would appreciate your comments and suggestions on issues to be examined in our report.

1. How would you define "Intelligent Workstation"? _____

2. Which of the following are required for a workstation to be classified an intelligent workstation? (Check those that apply)

- Communications capability (e.g., modem)
- Direct to Mainframe Connection (e.g., through a controller)
- Indirect to Mainframe Connection (e.g., LAN connection)
- Processing Capability
- Memory

3a. Do personal computers fit into your definition? Yes No

Why or why not? _____

3b. Do smart terminals fit? Yes No Why or why not? _____

4a. In your corporation, are you replacing terminals or typewriters with intelligent workstations? Yes No How many? _____

4b. Personal computers? Yes No How many? _____

4c. Are manual systems being replaced? Yes No

Explain: _____

4d. If you're migrating to intelligent workstations, how will you handle conversion?

5. What types of functions do your intelligent workstations typically handle?

Which of these functions are done locally on the IWS and which are done on the host processor?

	<u>IWS</u>	<u>HOST</u>
Word Processing/Document Preparation	<input type="checkbox"/>	<input type="checkbox"/>
Decision Support/Spreadsheets	<input type="checkbox"/>	<input type="checkbox"/>
Teleconferencing of any Type	<input type="checkbox"/>	<input type="checkbox"/>
Information Transfer	<input type="checkbox"/>	<input type="checkbox"/>
Electronic Mail	<input type="checkbox"/>	<input type="checkbox"/>
Information Retrieval, from the Corporate Data Bases and/ or Remote Systems	<input type="checkbox"/>	<input type="checkbox"/>
Graphics	<input type="checkbox"/>	<input type="checkbox"/>
Calendaring and Project Management	<input type="checkbox"/>	<input type="checkbox"/>
Voice Call Management ("Smart" Telephone Functions)	<input type="checkbox"/>	<input type="checkbox"/>
Compound Documents/Voice Annotation	<input type="checkbox"/>	<input type="checkbox"/>
CAD/CAM	<input type="checkbox"/>	<input type="checkbox"/>
Other Applications (specify) _____	<input type="checkbox"/>	<input type="checkbox"/>

6. What hardware do you consider to be most representative of intelligent workstations? _____

7a. Who makes purchasing decisions for IWS in your organization? _____

7b. Are any vendors preferred over others? Yes No Who? _____

8. How many intelligent workstations does your company currently have? _____

9. What hardware? _____

10. What level of personnel uses intelligent workstations, and when were their systems first installed? (check those that apply)

	<u>YEAR INSTALLED</u>
<input type="checkbox"/> Executives (VP or above)	_____
<input type="checkbox"/> Senior Managers (reporting to VPs)	_____
<input type="checkbox"/> Middle Managers	_____
<input type="checkbox"/> Line Managers	_____
<input type="checkbox"/> Professional Staff	_____
<input type="checkbox"/> Support Staff/Secretaries	_____

11. What type of support has IS provided users of intelligent workstations?

Training: _____

Programming Support: _____

Installation: _____

Maintenance: _____

Coordinated Purchasing: _____

Other (specify): _____

12. Do you think you'll be adding more workstations in the next two years? _____
If yes, what types, what purposes, and how many?

<u>TYPES</u>	<u>PURPOSES</u>	<u>NUMBER</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

13. Will these systems be replacement IWSs, or will they replace terminals, typewriters, or standalone PCs? Yes No If so, what percentages are replacements?

<u>REPLACEMENT</u>	<u>PERCENTAGE</u>
IWS	_____ %
Terminals	_____ %
Typewriters	_____ %
Standalone PCs	_____ %

14. Intelligent workstations cost more than terminals. How do you justify the additional expense? _____

15a. What have been the biggest benefits of intelligent workstations to your organization? _____

15b. What have been the biggest disappointments or unanticipated problems? _____

16. Is compatibility a problem? Yes No

17. How have you dealt with these problems? _____

18. Do the reports of health problems caused by CRTs and workstations concern you? Yes No

How do you respond to these risks? _____

19. Do your workstations require anything special in the way of physical location, lighting, furniture, user chairs? Yes No Are you doing anything about this need? Yes No

20. On a scale of 1 to 5, with 5 being "most likely," how likely do you think it is that you will be adding the following features or functions to your workstations in the next two years. . . or five years?

TWO YEARS ---- FIVE YEARS

Voice Recognition	<input type="checkbox"/>	<input type="checkbox"/>
Voice Command Software	<input type="checkbox"/>	<input type="checkbox"/>
Voice Response	<input type="checkbox"/>	<input type="checkbox"/>
Voice/Data Integration	<input type="checkbox"/>	<input type="checkbox"/>
Expert Systems/Artificial Intelligence	<input type="checkbox"/>	<input type="checkbox"/>
On-Desk Videoconferencing	<input type="checkbox"/>	<input type="checkbox"/>
Graphics	<input type="checkbox"/>	<input type="checkbox"/>
Compound Document Systems	<input type="checkbox"/>	<input type="checkbox"/>
Electronic Publishing	<input type="checkbox"/>	<input type="checkbox"/>
Image Processing (FAX)	<input type="checkbox"/>	<input type="checkbox"/>
LAN Connections	<input type="checkbox"/>	<input type="checkbox"/>
CBX Connections	<input type="checkbox"/>	<input type="checkbox"/>
Other Applications (specify) _____	<input type="checkbox"/>	<input type="checkbox"/>

21. Do you have any other comments? _____

THANK YOU!

APPENDIX C: PRODUCT PROFILES

- Product profiles provided closely fit the definition for intelligent workstations applied in this report. This list is meant to be representative and is by no means comprehensive. New products, features, and capabilities are announced frequently by vendors. Prices are given when available, but users are cautioned that prices are subject to change and are dependent on exact unit configurations.

A. APPLE: MACINTOSH 512K WITH MACPHONE

- Apple has announced its intention to penetrate the business market with Macintosh and has announced an inexpensive LAN to connect multiple Macs and peripherals. The company has also announced plans to offer a plug-in board for IBM PCs to connect to Macs.
- The 512K has four times the internal memory of the original Macintosh, allowing for larger documents and models and faster performance than the smaller system allowed. The smaller system can be upgraded with a memory expansion kit.
- The Macintosh XL (formerly, the Lisa) has even more memory, a larger screen, and a built-in 10-MB hard disk.

- The Macintosh 512K is priced as \$3,195. Modem and software are extra.
- Smart telephone features can be added with the \$199.95 MacPhone from Intermatrix, which includes a touch-tone telephone and supporting software storing a 200-name directory, with autodialing of 80 of those numbers. The system will log calls (with duration) for billing purposes, will look up area codes, and will support short notes.
- Further, with products such as the MicronEye from Micron Technology, or MacVision from Koala Technologies, video input can be stored and manipulated or transmitted in a freeze-frame videoconferencing application.

B. CONVERGENT TECHNOLOGIES: N-GEN

- Known primarily as an OEM manufacturer, the company began shipment of the N-GEN workstation in 1984.
- The units are composed of a set of modules that plug together in various configurations and include different CRTs, mass storage, keyboards, and specialized modules. Software is compatible with earlier company workstations.

C. CRYSTAL TECHNOLOGIES: PHONEWRITER

- PhoneWriter, designed as a secretarial workstation, will be available later in 1985.
- It has an eight-line display, integrated headset, and speakerphone. The workstation can function as a key set, a PBX station, or behind a Centrex.

- PhoneWriter supports one simultaneous voice/data channel and can connect to eight incoming voice lines. The company has integrated a 1,200-baud modem and an external 3-1/2-inch floppy disk storage device with 512K capacity.
- The system will operate on a proprietary operating system with calendar, messaging, and directories.
- Internal storage of 32K or 64K puts it on the low side of "intelligent."
- The company hopes to distribute the system through OEM and value-added channels.
- Price ranges between \$2,000 and \$3,000 depending on configuration.

D. DIGITAL EQUIPMENT CORPORATION: PROFESSIONAL 350/380 AND RAINBOW 190

- DEC features a choice of operating systems, with the multitasking Professional Operating System offering communications capabilities, sharing common file structure with the company's PDP-11 and VAX minicomputers.
- The 350 can be connected to various external devices, including the Interactive Video Information System or the Telephone Management System, to control video or voice information.
- As a node in a distributed processing environment, the 350 can run standalone applications, uploading and downloading information to other systems linked via Ethernet or serial lines.

- With Pro/Communications software, the 350 emulates VT52, VT102, or VT125 terminals and communicates asynchronously with a host.
- The 380 features increased graphics capability and higher speed than the 350. It supports windowing of four simultaneous applications.
- Application software includes word processing, data base management, spreadsheets, and statistical graphing. Pro/Graph allows presentation graphics to be used with text.
- DEC has recently repositioned the Rainbow Personal Computer, releasing (in July 1985) the Rainbow 190 designed for office use. Rainbow Office Workstation Software integrates with the company's All-in-1 office system. The Rainbow 190 is priced at \$6,495.
- Voice synthesis peripheral, DECTalk, converts ASCII text to speech for remote access, conversion of electronic mail, and training applications.

E. GRID: COMPASS

- The ten-pound portable unit comes with an electroluminescent screen, built-in modem, and jack for a handset, meaning the system serves as an intelligent telephone. It emulates the 2780/3780 and 3741-type devices.
- Preprogrammed, user-installable ROM cartridges increase storage and add applications such as integrated calendar, data base, autodialing, calculator, alarm, graphics, and various operating systems. Customized software can be burned into ROM.
- Information, storage, and printer sharing among as many as 58 users is supported through the company's GridServer.

- The Compass II is priced between \$6,795 and \$8,000 depending on RAM and configuration. ROM packs are priced between \$250 and \$500.

F. HEWLETT-PACKARD: HP 150

- This unit features touchscreen control and can function as a terminal in networks of larger computers, including IBM mainframes.
- The CRT screen has criss-crossing infrared light beams that, when interrupted by touch, allow user manipulation of the system.
- Minimally, the system comes with two 3-1/2-inch disk drives. Optional hard disks are available.
- HP offers an optional plug emulator card to link to IBM mainframes, and the HP 150 can also serve as a workstation connected to an HP 3000 or larger system running host software. As a standalone, the 150 operates under MS-DOS.
- The unit is an element in HP's Personal Productivity Center concept, integrating personal computing, data processing, office automation functions, and communications.
- The HP 150 is priced at approximately \$4,000.

G. IBM: 3270 PC

- The original 5271 models have a range of 256-640 K-bytes of main memory, as well as color monitors.
- The unit connects to any IBM system 370 series host through SNA local channels, non-SNA local channels, SDLC and BSC communications.
- The PC-DOS operating system supports standalone applications. Switching from the host-connected system to personal computing functions is done with one keystroke.
- The system is priced at \$3,785-6,210 depending on configuration.
- Other models in the product line provide mainframe-level graphics targeted for business, scientific, and engineering applications.

H. ITT: XTRA PERSONAL COMPUTER WITH VOICE COMMUNICATIONS SYSTEM

- The add-on option card, microphone, and speaker pod bring voice recognition, speech digitization and storage, speech playback, and voice command capabilities to the company's microcomputer.
- The system also supports telephone speed dialing, a phone directory, calendaring, and messaging.

I. ROLM: CEDAR

- Cedar combines IBM PC compatibility, a four-line digital phone with integrated speakerphone and "Personal Communications Software" with a 200-name directory, calendaring, messaging, calculator, and 3270 emulation. Cedar runs all IBM-PC software.
- Cedar connects with ROLM's CBX for computer access and functions such as PhoneMail. Simultaneous voice and data are carried on one twisted pair configuration.
- Each of two disk drives have 512K capacity. The keyboard, with ten softkeys, stores under the unit and has overlays to facilitate VT-100 and 3270 emulation.
- The system operates at 110-19.2 Kbps.
- ROLM also makes Juniper, an IBM-PC add-on board, to provide the same capabilities as the Cedar.
- Cedar is priced at \$4,245 and Juniper at \$1,390.

J. SYDIS: VOICESTATION 110

- This system, a workstation with integrated handset, is connected to the Sydis Information Manager with 3.2 gigabytes of storage (no local disk drive), which the company says will support more than 200 users.
- It works behind any PBX or on a Centrex system. A mouse or icon interface is optional.

- The system has IBM-3270-type and VT-100 terminal emulation capabilities through a protocol converter.
- VoiceStation operates under UNIX. Applications include data base, messaging, calendaring, calculator, and spreadsheets. It also supports voice annotation of text.
- Price ranges from \$5,000 to \$8,000 per workstation depending on configuration.

K. WANG PROFESSIONAL COMPUTER

- The unit supports word processing, spreadsheets, graphics, and data base management as well as other applications. It can work as a standalone workstation or with the company's Alliance office automation system and other company systems. The unit communicates via WangNet local area network or over telephone lines.
- It supports MS-DOS with CP/M being optional.
- The Audio Workstation works with Alliance to merge text and voice. Voice documents can be entered and edited using a telephone handset microphone. The Audio Workstation also supports voice mail messaging and autodialing.
- The Wang Professional Computer is priced between \$2,595 and \$6,400 depending on configuration.

L. XEROX: STAR 8010

- The first workstation implementing the mouse, icons, and windows for the user interface, this remote workstation uses twisted pair for connections and can connect through a PBX to an Ethernet LAN. The standalone model can transfer text to another model connected to Ethernet.
- The Star 8010 can emulate the IBM-3278 display terminal with SNA compatibility. As many as six 3278 windows can be opened simultaneously to different applications or mainframes.
- The system can also emulate DEC's VT-100 terminal.
- It is priced between \$9,000 and \$10,000.

M. ZAISAN: ES.3

- This system features a nine-inch CRT and is IBM-color-card compatible. It has an integrated handset and duplex speakerphone supporting two voice lines, one for simultaneous voice/data. It comes with one 360K disk drive but can be upgraded to two. An on-board modem operates at 300 baud, but 1,200 baud is optional.
- System software runs under MS-DOS, including a directory, calendaring, phone log, electronic messaging, scratch pad for short messages, and eight macros for automatic data base log on.
- The retractable keyboard has programmable keys. The system supports three-party audioconferencing and autodialing.

- ES.3 costs \$2,595. The company's ES.1, costing \$995, can be upgraded.
- It is sold primarily through OEM channels.

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

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